Transport of the Fry and Fingerlings of the Milk Fish *Chanos chanos* (Forskål)[1]

BY

T. A. MAMMEN[2]

Fisheries Extension Unit, Mandapam Camp

1. INTRODUCTION

Chanos culture is very popular in several SE. Asian countries, and extensive brackish water fish farms are exclusively devoted to its culture. The main points in favour of chanos culture are : (1) Ready availability of fish seed in creeks, lagoons, and salt pans connected to the sea ; (2) Capacity of the fry and fingerlings to rapidly acclimatize to freshwater conditions ; and (3) Good growth in fresh water, particularly hard water and highly alkaline water, in which the growth of major carp is poor.

From 1931 onwards the culture of chanos was attempted, particularly by the Department of Fisheries, Madras, but no appreciable progress was achieved. Ganapathi *et al.* (1950), Panikkar *et al.* (1952, 1958) and Viswanathan *et al.* (1952) worked out certain interesting aspects of the adaptability and acclimatization of chanos to low salinities. In the wake of this interest several chanos collection centres were located on the east and west coasts of India but, with the advent of improved technique and the shift of emphasis to major carp culture, chanos culture in India has been almost given up. The present production of major carp seed is only about 1% of the total requirements and the culture of chanos admirably fits into some of the places considered unfit for fish culture. The main difficulties in utilizing chanos seed resources are the inefficiency of the methods hitherto used for transporting chanos, the disappointing results of direct stocking of chanos fry, the equally disappointing growth of fry in nurseries, and the very great difficulty of transporting chanos fingerlings.

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[2] Present address : Ministry of Food and Agriculture, (Department of Food), New Delhi.

In view of the extensive resources of chanos fry and fingerlings in and around Mandapam, the present author undertook a study of the transport of chanos fry and fingerlings during 1959-62. Although, owing to the winding up of the Fisheries Extension Unit at Mandapam Camp and the transfer of the author to Hyderabad, it was not possible to complete the work, some observations were made, which would help towards the economic utilization of the chanos fry and fingerling resources.

2. Transport of Chanos Fry

2.1. *Chanos fry collection and transport*

The material for the present study was collected from Chinnapalem creek near Pamban. Fry were collected by dragging with a piece of cloth, usually early in the morning. Collection was easy, from a hundred to a thousand fry being collected with each haul. The fry were then taken by head-load in milk-can type containers to Pamban, where they were acclimatized to low salinities, by periodically replacing ¼th water with Well water, this process being repeated till a salinity of 5‰ or so was obtained. The fry were then transported by rail in 40-gallon milk-can type containers, each filled with 25 gallons of water holding 250 to 400 numbers of fry. A mortality varying from 10 to 30% was usually reported after about 6 hours of train journey. As this mortality was considered excessive, alternate modes of transport were attempted.

2.2. Preliminary experiments were conducted, using small plastic bags filled with 175 c.c. of sea-water holding varying numbers of fry, to determine optimum concentrations. The bags were then filled with oxygen and kept for observation on the incidence of mortality. The results are given in Table 1.

It may be seen that, even at a very high concentration of 200 fry of 1·3 to 1·5 cm. size per 175 c.c. of sea-water, no significant mortality was noticed up to 36 hours. At a concentration of 100 fry, mortality was negligible even at 72 hours. With the latter concentration, trial consignments were sent to Madurai, a distance of 90 miles by road and rail. The procedure was as follows.

Chanos fry were obtained from Chinnapalem creek and transported to the Fisheries Extension Unit, Mandapam Camp, by milk-can type container each with 1000 fry, filled to capacity with water from the collection ground. The mouth of the container was plugged with a laboratory towel to avoid splashing during transport. The journey was performed partly by head-load (3 km.), partly by train (6 km.), and partly by Jeep (3 km.). No appreciable mortality was noticed. The fry were then transferred to enamelled trays and gradually acclimatized to low salinity conditions as described above. The entire process of trans-

TABLE 1

MORTALITY OF CHANOS FRY (OF 1·3-1·5 CM. SIZE) AT DIFFERENT CONCENTRATIONS IN 175 C.C. OF SEA-WATER PACKED IN SMALL PLASTIC BAGS WITH OXYGEN UNDER SLIGHT PRESSURE

Sl. no. of experiment	Quantity of water	No. of fry introduced	Mortality at the end of						Remarks
			12 hrs.	24 hrs.	36 hrs.	48 hrs.	60 hrs.	72 hrs.	
1	175 c.c.	25	nil	nil	nil	nil	nil	nil	
2	do.	25	1	1	1	1	1	1	Those dying early are probably injured fry
3	do.	50	nil	nil	nil	nil	nil	nil	
4	do.	50	nil	nil	nil	nil	nil	nil	
5	do.	75	1	1	1	2	2	2	
6	do.	75	2	2	2	2	2	2	
7	do.	100	nil	nil	nil	nil	nil	nil	
8	do.	100	nil	nil	nil	nil	nil	nil	
9	do.	150	1	1	2	14	55	95	
10	do.	150	1	2	4	20	78	100	
11	do.	200	1	1	15	47	200	..	
12	do.	200	nil	1	16	73	172	200	
13	do.	300	2	12	300	..	..	..	
14	do.	300	6	27	300	..	..	..	

NOTE.—The fry were packed in approximately 4 hours after reaching headquarters and 8 hours after collection.

port, and acclimatization, took 6-10 hours. The conditioned fry were counted and removed by petri-dish to finger-bowls, each receiving 100 in number. The water in each finger-bowl was renewed and made up to 175 c.c. and was transferred to plastic bags specially made for the purpose from 200 gauge lay-flat tubing ; oxygen from an oxygen cylinder was passed into the plastic bag till it filled up and exerted a reasonable pressure. The free end of the plastic bag was twisted and double knotted. A deal-wood box, 54·5 cm. × 31·5 cm. × 33 cm. could hold 40 such bags in four rows in two tiers. The weight of the consignment was 10·2 kg., of which 7·4 accounted for the dead weight of the box. A few trial consignments were despatched to Madurai, where they were opened 20 to 48 hours after packing. In most of the cases the mortality was nil, in a few it ranged from 1 to 4%. One interesting feature was that the results from the transport tests did not appreciably vary from the standing tests. Hence the bulk of the remaining tests were standing tests. In some cases, for example where optimum surface area had to be determined, the jolting effect of the rail transport was simulated by stacking the bags on a weak table and running off and on an old table fan placed on this table.

2.3. *Causes of mortality of chanos fry*

2.3.1. *Handling mortality*

Chanos in all stages was extremely delicate and highly susceptible to injury. A good number were accidentally killed during collection, partly due to injury and partly to the clogging of the gills as a result of the stirring of the silty bottom during dragging. Rough handling invariably resulted in mortality. Thus, if after impounding the fry in the cloth used for collection, the water was drained with the object of measuring the collection, a high mortality would result. To avoid this mortality the fry were transferred with water using a petri-dish for the purpose.

2.3.2. *Medium of transport*

Despite their delicateness, chanos fry showed extreme powers of osmoregulation and could even stand direct transfer from sea-water to fresh water. The question for consideration was which of the salinity concentrations would be most conducive to maximum efficiency. To elucidate this point, fry of 1·7 to 1·9 cm. size were packed with oxygen in lots of 200 in bags, each containing 380 c.c. of water, some lots in collection-ground water, some in well water, some in a mixture of the two, and some in tap water. Where changes in salinity were involved, they were gradually acclimatized. The packed bags were left undisturbed and the occurrence of mortality noted at definite intervals. The physical properties of water were noted before and after the experiment. The results are presented in Table 2. It may be seen that the incidence of mortality was early in tap water, followed by well water, then in the mixture of well water and collection-ground water. Analysis of water

TABLE 2

EFFECT OF MEDIUM OF TRANSPORT ON THE SURVIVAL OF 200 FRY OF 1·3-1·5 CM. LENGTH IN 380 C.C. OF WATER WITH A SURFACE AREA OF 22·84 SQ. CM. IN SMALL PLASTIC BAGS

Sl. No. of expt.	Type of water used	Physical properties of water before expt.		Progressive Mortality at the end of								Physical properties of water after expt.	
		Salinity	pH	24 hrs.	40 hrs.	70 hrs.	90 hrs.	96 hrs.	112 hrs.	118 hrs.	136 hrs.	pH	Oxygen content
15	Collection ground sea water	38‰	8·4	0	1	1	2	4	24	35	135	7·5	1·14 ml/L
16	do.	do.	do.	0	0	0	0	31	35	40	140	do.	1·88 ml/L
17	do.	do.	do.	0	0	1	2	3	15	25	145	do.	2·36 ml/L
18	Well Water	1·5‰	8·0	2	2	2	10	15	105	discontinued		7·5	2·05 ml/L
19	do.	do.	do.	0	0	1	6	30	160	discontinued		do.	2·34 ml/L
20	do.	do.	do.	6	8	10	35	150		discontinued		do.	2·68 ml/L
21	Ordinary sea-water and well water	20‰	8·2	0	1	1	2	12	55	75	180	7·5	1·5 ml/L
22	do.	do.	do.	1	2	3	5	7	40	60	175	do.	1·25 ml/L
23	do.	do.	do.	0	0	0	6	6	31	32	165	do.	2·05 ml/L
24	Tap Water	3·5‰	8·2	5	5	8	30	190				7·5	..
25	do.	do.	do.	4	6	9	198					do.	1·71 ml/L
26	do.	do.	do.	5	6	26	200					do.	..

Mean Temperature 31°C.

at the end of the experiment showed a pH of 7·5 and sufficient dissolved oxygen in all cases.

The reason for mortality in the low salinities could be either (1) after-effect of acclimatization or (2) effect of accumulation of metabolic waste products. From published accounts (Panikkar *et al.* 1952) it appears unlikely that the former was the reason. This view is supported by the fact that, when larger quantities of water were provided, mortality was delayed. The limiting factor therefore appears to be the accumulation of waste products, whose ill effects are experienced early in the absence of buffer action of the saline medium. The actual physiological break-down responsible for the high degree of mortality between 118 hours and 136 hours, even under high salinity conditions, appears to have been starvation, as is revealed in a subsequent experiment. As the mortality up to 30-hour period is low in all cases and the duration of transport under field conditions was well within this period, all these media could be adopted, although the saline medium ensured a greater margin of safety. The final arrangement was as follows. After the collection of fry, about 6 hours were allowed for the emptying of the stomach—this period was conveniently used for gradually acclimatizing the fry to a salinity of say 20‰. The fry were then packed in saline medium and transported. At the salinity concentration of 20‰, the osmotic pressure was more or less similar to that of the body fluid of the fry, and this would facilitate the removal of the waste products and offer a certain amount of buffering action against the accumulation of carbon dioxide. The final acclimatization to fresh water was done after the completion of the transport.

2.3.3. *Transportation mortality*

This was due to one or more of the following reasons.

2.3.3.1. *Injury sustained.* As already mentioned any injury sustained by the fry ended in mortality. During transportation in milk-can type containers the fry were very liable to get injured by violent splashing. When these metal containers were used, say for short distance journey, splashing was avoided by filling the container to the very top and closing the mouth. The higher percentage of survival reported with the small plastic bag was essentially due to the resilience of the plastic bag cushioning out the splashing to a great extent; also the small surface area of water reduced the amplitude of the splashing.

2.3.3.2. *Lack of proper conditioning.* Conditioning of chanos fry prior to transport involved both acclimatization and physical conditioning. Since final culture was intended in fresh water, acclimatization to it at some stage was necessary. The physical conditioning was to prepare for a crowded journey so that the fry in transport would not suffer from crowding and pollute the medium by vomiting and defaecation. However, prolonged physical conditioning was unnecessary, for chanos fry occur crowded in the natural environment. The alimentary canal at this sage is short and the contents are quickly voided. So conditioning for 6 hours was sufficient. However, the medium had to be periodically replaced, because the fry would otherwise reinjest the faecal matter.

2.3.3.3. *Lack of sufficient oxygen.* The oxygen intake of chanos fry being of the order of 0·0002 c.c./fry/hour, the concentration of 100 fry per 175 c.c. arrived at was quite satisfactory for normal duration of transport. In actual transport, besides the oxygen contained in the medium, oxygen was replenished from the atmosphere and the exact quantity going into solution depended on (1) water surface area, (2) the pressure and the percentage of oxygen contained in the atmosphere.

2.3.3.3.1. *Water surface area.* Increased surface area favoured absorption of oxygen, but caused violent splashing and therefore more mortality. To determine optimum surface area, experiments were conducted with 4 distinct surface areas, keeping 200 fry of 1·7 to 1·9 cm. length in 350 c.c. sea-water as constant in all cases. These plastic bags were packed with oxygen and left in plastic (pickle) jars of appropriate surface area and the jolting effect was artificially simulated. Table 3 shows the optimum surface area for this particular volume and size of fry to be 25 sq. cm. The mortality with larger surface area was considerable, and was caused by injury sustained during splashing. With a limited surface area of 14 sq. cm. the splashing was negligible and the fry were not injured, but mortality set in at 48 to 60 hours and was quite evident at 72 hours. This appeared to be due to oxygen deficiency in the absence of adequate oxygen dissolution on acount of the limited surface area.

2.3.3.3.2. *Pressure and percentage of oxygen contained in the atmosphere* determines the extent of oxygen dissolution (Dalton's law and Henry's law). In an open system the rate of dissolution was the least as there was only 20% oxygen and no extra pressure. This could be improved by providing an atmosphere of oxygen (i.e. 100% oxygen) and maintaining it under pressure, as in oxygen packing. Experiments were conducted to find out the relative merits of different packings. Some lots of bags were kept open. In the second lot the bags enclosed a certain amount of atmospheric air, and the free end of the bag was twisted once or twice and knotted so that the air was compressed and exerted a mild pressure on the water below. The third lot was packed with oxygen in the usual way, also maintaining a slight oxygen pressure.

The results presented in Table 4 show that, for short distance transport taking up to 24 hours, even open transport in plastic bags was possible, although not recommended because of the chance of accidental spilling. Merely keeping air under mild pressure prolonged the period of safe transport to 36 hours, and oxygen transport was necessary in cases requiring longer duration of transport.

TABLE 3

EFFECT OF SURFACE AREA ON THE SURVIVAL OF 200 CHANOS FRY OF 1·7-1·9 CM. SIZE IN 350 C.C. OF DILUTED SEA-WATER OF SALINITY 20‰, pH 8·2, AND MEAN TEMPERATURE 30·5°C.

Sl. No. of expt.	Surface area of water in plastic bag, in sq. cm.	Mortality at the end of						Remarks
		12 hrs.	20 hrs.	36 hrs.	48 hrs.	60 hrs.	72 hrs.	
27	14	nil	nil	nil	1	6	28	
28	14	nil	nil	nil	nil	1	22	
29	25	nil	nil	nil	nil	nil	2	
30	25	nil	nil	nil	nil	nil	nil	
31	38·5	16	18	28	48	60	80	
32	38·5	14	14	18	27	40	53	
33	75·5	24	68	154	200			Water was slightly turbid at the end of experiment.
34	75·5	48	124	190	200			do.

NOTE.—The jolting effect of transport was artificially simulated in this experiment.

TABLE 4

EFFECT OF MILD PRESSURE AND OXYGEN ON THE SURVIVAL IN TRANSPORT OF 100 FRY (OF 1·3 TO 1·5 CM.) IN 175 C.C. OF WATER MADE UP OF EQUAL QUANTITIES OF SEA-WATER AND WELL WATER, SURFACE AREA APPROXIMATELY 25 SQ. CM.

Sl. No. of expt.	Mode of packing	Mortality at the end of							Dissolved Oxygen concentration at the end of expt.
		12 hrs.	24 hrs.	36 hrs.	48 hrs.	60 hrs.	72 hrs.	96 hrs.	
35	Bags kept open (air without pressure)	1	4	81	100				1·0%
36	do.	1	3	95	100				nil
37	Bags packed with Oxygen under slight pressure	nil	nil	nil	nil	nil	nil	6	94·33%
38	do.	2*	2	2	2	2	3	9	83·48%
39	Bags packed with air under slight pressure	1	1	5	58	100			2·2%
40	do.	2*	2	2	42	95	100		1·8%

Mean Temperature—30·5°C.; pH=8·2; S=20‰.

* Presumably weak or injured fry.

2.3.4. *Starvation mortality*

From the Tables 1, 2, and 3 it was seen that even under the best conditions mortality of chanos fry occurred after the 5th day. This was suspected to be due to starvation, as provision of larger quantities of water did not improve the situation. In a large basin of 400 sq. cm. surface area, filled with 5 litres of sea-water 200 healthy fry were kept and the incidence of mortality noted at intervals. The dead fry when noticed were promptly removed to avoid fouling of the water. No mortality was observed until after the 5th day, 8% mortality occurred on the 6th day, 26% mortality (progressive) on the 7th day, 61% on the 8th day, and complete mortality on the 10th day. These deaths were evidently due to starvation. The natural endurance being thus limited, it was necessary that acclimatization, conditioning, and transport were completed and the fry were planted in nurseries within this short period. It is therefore necessary to restrict the combined period of acclimatization and conditioning prior to transport to a short period, say six hours.

2.3.5. *Post-planting mortality*

Growth of chanos fry in the natural environment is very rapid. They attain 5-8 cm. length (3 to 7·5 gm. weight) in one month and 8 to 16 cm. length (7·5-38 gm.) in the second month. As against this, growth in nurseries was negligible and was associated with a very high incidence of mortality. As direct stocking of fry was a failure, it was felt that naturally-occurring chanos fingerlings should be utilized for stocking.

3. Transport of Chanos Fingerlings

Chanos fingerlings occurred in the shallow lagoons in and around Mandapam, including those of the adjoining islands, in such large numbers that, during the late summer months, a fishery of chanos fingerlings existed in this area. Preliminary attempts to stock these large-sized fingerlings yielded good results in Ramanathapuram area. Similar good results were recorded from Vellore Moat farms (1953). The extreme difficulties in transport might have been the main reason for chanos fingerlings not being taken up for large scale stocking.

3.1. *Collection of chanos fingerlings*

At Pamban chanos fingerlings were caught mostly by scare line fishing. At Mandapam, *kondavalai* (an inshore drag net with wooden sticks at regular intervals keeping the head rope and foot rope at a fixed distance) was used. The *kondavalai* was dragged by 6 to 10 fishermen in the shallow regions of the lagoon. During low tide the fingerlings got stranded in the pools and collection was particularly easy, anything up to 2500 fingerlings being collected per hour per net.

The freshly collected fingerlings being over-active, hand picking led to loss of scales and consequent fungal attack and injury to the internal organs. The excited fingerlings knocked about in the container, bruising their body and polluting the water medium by the fallen scales and vomited and defaecated matter. The mortality was so great that in one instance the entire collection of about 2000 fingerlings died in the short period between collection and actual transport.

3.2. *Oxygen consumption of freshly caught chanos fingerlings*

Viswanathan & Tampi (1952) and Job (1957) worked out the oxygen consumption of chanos in relation to size. But the oxygen consumption reported appeared to be that of routine metabolism of conditioned fish as the figures did not amply reflect the oxygen requirements of freshly caught fingerlings. In actual practice it was necessary to know of the optimum quantity of water required per fingerling to keep them alive. With this object a series of trials were made using small cement cisterns having a surface area of approximately 0·8 square metres. Each cistern was filled with 35 gallons of water made up of equal quantities of fresh water and sea-water. Concentrations varying from 5-500 freshly caught fingerlings of size 7 to 9 cm. were kept in the cisterns. Mortality, except in the lower concentrations, was so rapid that it was not possible to keep a record. Having got an idea that the optimum number was between 10 and 20 fingerlings per cistern, the experiments were repeated to arrive at the optimum number. Fingerlings that died shortly after the experiment began were replaced, their mortality being considered due to injuries sustained during collection. The optimum number was found to be about 17. This indicated that about 2 gallons (9 litres) of water were required to sustain a single fingerling — a requirement inconsistent with economical transport. The solution was one of reducing the rate of oxygen uptake. Of the two methods available, (1) use of anaesthetics and (2) physical conditioning, the latter alone was tried.

3.3. *Conditioning of chanos fingerlings.*

The fingerlings, immediately after impoundment in *kondavalai*, were transferred with minimum handling to conditioning boxes with velon screen sides, kept immersed in water. The conditioning boxes were then transported, where possible, through water and, where overland transport was necessary, in water-proofed jeep trailers filled with salt water. Spilling of water from the trailer was minimised by firmly tying a thin tarpaulin over the trailer mouth. To begin with, the conditioning boxes with the fingerlings were kept immersed in the channel leading to the Marine Fish Farm at Mandapam. In due course the screen meshes got plugged with silt and not more than 150 fingerlings could be kept alive in a 105-gallon conditioning box. By periodical cleaning of the mesh, it was possible to keep alive 200 fingerlings. The conditioning box was then moored to an anchor in the open sea, a little beyond the zone of turbulence. In these conditions a concentration of 250 fingerlings not only did not result in appreciable mortality but the fingerlings continued to be active, even after 4 days. Dissection revealed that they were getting sufficient food ; starvation was evidently necessary to reduce the activity. For this purpose a 6000-gallon cemented tank at the Fisheries Campus was filled with water, partly salt and partly fresh, and the fingerlings in the conditioning box were left to starve in the tank. This procedure worked, the fingerlings became progressively less active, and several batches of 200 to 250 fingerlings were successfully conditioned.

Whereas freshly captured chanos fingerlings knocked about in frenzied excitement at the sound of an approaching foot-step the same fingerling of size 6-10 cm. did not respond to the sound of foot-steps after about a week's conditioning, though it could be excited by the beam of a flash light. After another week flashing a light merely induced a scattering of the shoal, and after 3 weeks of conditioning even this response was hard to detect. Conditioning time increased with the size of the fingerlings.

3·4. *Starvation mortality*

Unlike chanos fry, chanos fingerlings were hardy and, in a test case, survived 56 days of starvation. Though they appeared emaciated with somewhat disproportionately large heads, some of them grew very well when stocked in tanks near Chittarakottai—apparently the prolonged starvation did not impair their capacity for growth.

3·5. *Effect of starvation on the efficiency of chanos fingerling transport*

An experiment was conducted to determine the optimum number of 56 days conditioned chanos fingerlings. In standard plastic bags each containing 6 litres of water, 5, 10, 20, 30, 40, 50 and 60 fingerlings respectively were introduced and packed with oxygen. No mortality was seen in any lot in a standing test of 6 days' duration. The maximum efficiency in this case worked out to 10 fingerlings per litre as against 1 fingerling per 9 litres for unconditioned fingerlings. In actual practice such prolonged conditioning would be difficult, and the observation reported merely illustrates the possibility of economic transport by starving the fingerlings.

In order to arrive at the concentrations of fingerlings at various levels of starvation a few further experiments were conducted. The results obtained are presented in Table 6.

Since the season expired soon after and the author was transferred, by the next season these experiments could not be repeated on a statistical design.

TABLE 5

EFFECT OF CONDITIONING ON THE LIMITS OF CONCENTRATION OF CHANOS FINGERLINGS AS REVEALED IN STANDING TESTS IN STANDARD SIZE PLASTIC BAGS PACKED WITH OXYGEN UNDER SLIGHT PRESSURE, USING WATER OF LOW SALINITY (5‰)

Serial No. of expt.	Length of fingerling in cm.	No. of fingerlings.	Qty. of water in litres.	Qty. of water per fingerling in c.c.	Period of conditioning before packing.	Mortality recorded at the end of							Remarks on concentration for the conditioning given.
						6 hrs.	12 hrs.	18 hrs.	24 hrs.	30 hrs.	36 hrs.	48 hrs.	
41	4-6	60	9	150	12 days	nil	nil	7	—	—	—	—	
42	4-6	49	9	180	8 do.	nil	nil	nil	nil	nil	nil	6	Safe.
43	4-6	60	9	150	12 do.	nil	nil	nil	nil	nil	nil	nil	do.
44	7 (av.)	25	6	240	1½ do.	nil	2	2	2	3	5		Slightly excessive.
45	7 (av.)	60	9	150	7 do.	nil	nil	6	discontinued				Excessive.
46	7 (av.)	70	9	129	7 do.	nil	6	11	discontinued				do.
47	7 (av.)	40	9	225	12 do.	nil	nil	nil	nil	nil	nil	nil	Safe.
48	7·5 (av.)	60	9	150	7 do.	nil	nil	3	7	discontinued			Excessive.
49	7·5 (av.)	75	9	120	7 do.	nil	nil	6	11	discontinued.			
50	8 (av.)	25	9	360	3 hrs.	15	23	discontinued					Obviously in excess.
51	8 (av.)	20	9	450	3 do.	20	20	discontinued					do.
52	8 (av.)	25	9	360	1 day	2	4	discontinued					Obviously in excess.
53	8 (av.)	50	9	180	7 days	nil	nil	nil	1	15			Slightly in excess.
54	8 (av.)	50	9	180	7 do.	nil	nil	23					Excessive.

55	8 (av.)	40	9	180	12 do.	nil	nil	nil	nil	nil	22	49	Slightly in excess.
56	8·5 (av.)	60	9	150	7 do.	nil	nil	1	15	discontinued			Excessive.
57	9 (av.)	20	9	450	1 day	1	1	discontinued					do.
58	9 (av.)	20	6	306	1½ days	nil	1	1	2	7			do.
59	9·5 (av.)	35	9	257	7 do.	nil	nil	9					do.
60	9·5 (av.)	40	9	225	7 do.	nil	nil	nil	nil	nil	2		Optimum.
61	9·5 (av.)	50	9	180	7 do.	nil	nil	12	41				Excessive.
62	10 (av.)	20	9	450	1 day	2	6	discontinued					do.
63	10 (av.)	20	9	450	1½ days	2	6	14	discontinued				do.
64	10 (av.)	35	9	257	7 do.	nil	nil	9	discontinued				do.
65	10·5 (av.)	35	9	257	7 do.	nil	nil	3	25	discontinued			do.
66	10·5 (av.)	20	9	450	7 do.	nil	nil	nil	discontinued				Optimum.
67	11 (av.)	10	9	900	7 do.	nil	2	2	5	8			Excessive.
68	11·5 (av.)	25	9	360	8 do.	nil	nil	1	14	18	24	25	do.
69	12 (av.)	10	9	900	1½ do.	nil	1	1	4	discontinued			do.
70	12 (av.)	10	9	900	7 do.	nil	1	1	4	10			do.
71	12 (av.)	18	9	500	12 do.	nil	nil	nil	nil	nil	nil	1	Optimum.
72	12·5 (av.)	25	9	360	7 do.	nil	nil	2	16				
73	13·5 (av.)	10	9	900	8 do.	nil	nil	nil	nil	nil	nil	nil	Safe.
74	10 (av.)	4	9	2112	8 do.	nil	nil	nil	nil	nil	nil	nil	Safe.

TABLE 5

EFFECT OF CONDITIONING ON THE LIMITS OF CONCENTRATION OF CHANOS FINGERLINGS AS REVEALED IN STANDING TESTS IN STANDARD SIZE PLASTIC BAGS PACKED WITH OXYGEN UNDER SLIGHT PRESSURE, USING WATER OF LOW SALINITY (5‰)

Serial No. of expt.	Length of fingerling in cm.	No. of fingerlings.	Qty. of water in litres.	Qty. of water per fingerling in c.c.	Period of conditioning before packing.	Mortality recorded at the end of							Remarks on concentration for the conditioning given.
						6 hrs.	12 hrs.	18 hrs.	24 hrs.	30 hrs.	36 hrs.	48 hrs.	
41	4-6	60	9	150	12 days	nil	nil	7	—	—	—	—	
42	4-6	49	9	180	8 do.	nil	nil	nil	nil	nil	nil	6	Safe.
43	4-6	60	9	150	12 do.	nil	nil	nil	nil	nil	nil	nil	do.
44	7 (av.)	25	6	240	1½ do.	nil	2	2	2	3	5		Slightly excessive.
45	7 (av.)	60	9	150	7 do.	nil	nil	6	discontinued				Excessive.
46	7 (av.)	70	9	129	7 do.	nil	6	11	discontinued				do.
47	7 (av.)	40	9	225	12 do.	nil	nil	nil	nil	nil	nil	nil	Safe.
48	7·5 (av.)	60	9	150	7 do.	nil	nil	3	7	discontinued			Excessive.
49	7·5 (av.)	75	9	120	7 do.	nil	nil	6	11	discontinued.			
50	8 (av.)	25	9	360	3 hrs.	15	23	discontinued					Obviously in excess.
51	8 (av.)	20	9	450	3 do.	20	20	discontinued					do.
52	8 (av.)	25	9	360	1 day	2	4	discontinued					Obviously in excess.
53	8 (av.)	50	9	180	7 days	nil	nil	nil	1	15			Slightly in excess.
54	8 (av.)	50	9	180	7 do.	nil	nil	23					Excessive.
55	8 (av.)	40	9	180	12 do.	nil	nil	nil	nil	nil	22	49	Slightly in excess.
56	8·5 (av.)	60	9	150	7 do.	nil	nil	1	15	discontinued			Excessive.
57	9 (av.)	20	9	450	1 day	1	1	discontinued					do.
58	9 (av.)	20	6	306	1½ days	nil	1	1	2	7			do.
59	9·5 (av.)	35	9	257	7 do.	nil	nil	9					do.
60	9·5 (av.)	40	9	225	7 do.	nil	nil	nil	nil	nil	2		Optimum.
61	9·5 (av.)	50	9	180	7 do.	nil	nil	12	41				Excessive.
62	10 (av.)	20	9	450	1 day	2	6	discontinued					do.
63	10 (av.)	20	9	450	1½ days	2	6	14	discontinued				do.
64	10 (av.)	35	9	257	7 do.	nil	nil	9	discontinued				do.
65	10·5 (av.)	35	9	257	7 do.	nil	nil	3	25	discontinued			do.
66	10·5 (av.)	20	9	450	7 do.	nil	nil	nil	discontinued				Optimum.
67	11 (av.)	10	9	900	7 do.	nil	2	2	5	8			Excessive.
68	11·5 (av.)	25	9	360	8 do.	nil	nil	1	14	18	24	25	do.
69	12 (av.)	10	9	900	1½ do.	nil	1	1	4	discontinued			do.
70	12 (av.)	10	9	900	7 do.	nil	1	1	4	10			do.
71	12 (av.)	18	9	500	12 do.	nil	nil	nil	nil	nil	nil	1	Optimum.
72	12·5 (av.)	25	9	360	7 do.	nil	nil	2	16				
73	13·5 (av.)	10	9	900	8 do.	nil	nil	nil	nil	nil	nil	nil	Safe.
74	10 (av.)	4	9	2112	8 do.	nil	nil	nil	nil	nil	nil	nil	Safe.

TABLE 6

RESULTS OF CHANOS FINGERLING TRANSPORT USING JEEP TRAILER WITH FINGERLINGS PACKED WITH OXYGEN IN STANDARD PLASTIC BAGS SUPPORTED IN CONVERTED KEROSINE TINS—DISTANCE 100 MILES; DURATION OF ACTUAL JOURNEY 5 HRS.

Serial No.	Length of fingerling in cm.	No. of fingerlings	Quantity of water in litres	Quantity of water per fingerling (in c.c.)	No. of days of conditioning before packing	Actual duration between time of packing and time of release	Mortality at the time of release
75	4–7	70	9	129	10	13 hrs.	1
76	4–8	54	9	167	14	13 ,,	nil
77	4–8	70	9	129	5	13 ,,	1
78	4–8	60	12	200	4	9 ,,	2
79	5–8	50	12	240	14	12 ,,	nil
80	5–9	55	12	218	5	10 ,,	2
81	5–9	45	12	267	5	10 ,,	3
82	5–9	50	12	240	5	11 ,,	2
83	5–9	50	12	240	5	9 ,,	2
84	6–10	46	12	267	5	11 ,,	nil
85	6–10	45	12	267	5	12 ,,	4